

PSYCHOPSOID NEUROPTERA (PSYCHOPSIDAE, OSMYLOPSYCHOPIDAE) FROM THE QUEENSLAND TRIASSIC

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Abstract

Six species of psychopsoid neuropterans are recorded from the southeastern Queensland Late Triassic Blackstone Formation at Denmark Hill and Dinmore, the Late Triassic Mount Crosby Formation at Mount Crosby, and the early Middle Triassic Gayndah Formation at Gayndah. *Triassopsychops superbus* Tillyard (previously known from Denmark Hill, newly recorded from Dinmore) has a suite of apomorphies confirming its earlier placement in Psychopsidae. Additional material of *Osmylopsychops spilleriae* Tillyard (type species of the family Osmylopsychopidae) (previously known from Denmark Hill and Mount Crosby, newly recorded from Dinmore) confirms the presence of a recurrent humeral vein and demonstrates its high degree of intra-specific variation in size and venation. *Petropsychops superbus* Riek (previously known from Denmark Hill, newly recorded from Mount Crosby), with M and Rs uniquely structured basally, is retained in Osmylopsychopidae, although its strongly pectinate M is similar to some species of the Mesozoic psychopsoid family Kalligrammatidae. *Archepsychops triassicus* Tillyard (Denmark Hill), possibly conspecific with *O. spilleriae*, is known only from its fragmentary holotype and is retained for convenience in Osmylopsychopidae. *Protopsychopsis venosa* Tillyard (Denmark Hill) is known only from its holotype, which is too fragmentary to be considered any more than Neuroptera *incertae sedis*. The sixth species, *Gayndahpsychops carsburgi* gen. et sp. n., from the early Middle Triassic of Gayndah, is a small osmylopsychopid with CuA extensively pectinate.

Introduction

In the fossil insect literature, the term 'psychopsoid' is used for those fossil lacewing species with a suite of wing characters broadly similar to those of the extant Psychopsidae, viz. wing broad, generally no more than twice as long as wide, somewhat triangular, with apical margin truncate; costal space broad, especially in the forewing, with recurrent humeral vein; Sc, R₁ and Rs strongly aligned; venation dense, Rs with numerous, usually closely parallel, pectinate branches. The psychopsoid clade is generally considered to comprise four families: the extant and fossil Psychopsidae, and the extinct Mesozoic families Osmylopsychopidae, Brongniartiellidae and Kalligrammatidae (Makarkin *et al.* 2013, and see discussion in Yang *et al.* 2012). The Mesozoic Aetheogrammatidae (Ren and Engel 2008) has also been included, but the placement of this aberrant family remains problematical.

In Australia, fossil psychopsoids have previously been recorded from two Triassic localities in southeastern Queensland. Tillyard (1917, 1919, 1922, 1923) described *Protopsychopsis venosa* Tillyard, *Archepsychops triassica* Tillyard (now *A. triassicus*, see ICZN Article 30.1.4.3), *Triassopsychops superba* Tillyard (now *T. superbus*, ICZN Article 30.1.4.3), and *Osmylopsychops spilleriae* Tillyard from the Blackstone Formation at Denmark Hill. Riek (1955) recorded *A. triassicus* and *O. spilleriae* from the Mount Crosby Formation at Mount Crosby and, in 1956, described

Petropsychops superba Riek (now *P. superbus*, ICZN Article 30.1.4.3) from Denmark Hill. Both Tillyard and Riek considered *T. superbus* as the oldest true psychopsid and Riek (1955) placed the other four species in his newly established family Osmylpsychopidae, unaware that Martynova had established the same family in 1949 (but as Osmylpsychopsidae, see Makarkin and Archibald 2005).

In recent years, local fossil enthusiast Allan Carsburg has collected many valuable new specimens of fossil psychopsoids from Mount Crosby and from a different exposure of the Blackstone Formation at Dinmore, also in southeastern Queensland. There is now a second specimen of *T. superbus* (from Dinmore) and a nice series of *O. spillerae* from both Mount Crosby and Dinmore. Additionally, a new psychopsoid species has been collected by the author from the Middle Triassic Gayndah Formation near Gayndah, again in southeastern Queensland. The availability of this new material has prompted the present review of the Queensland Triassic psychopsoid fauna. The purpose of the present work, therefore, is to re-examine and, for the first time, provide accurate line drawings of the holotypes of *P. venosa*, *A. triassicus*, *T. superbus*, and *P. superbus*, provide new information on the venation of *O. spillerae* further to Lambkin (1992), describe the new species from Gayndah and discuss the family relationships of the species.

Specimens have been identified as fore- or hind wings by the relative width of the costal space (much wider in forewings) and the convexity or concavity of CuA (convex in forewings, concave in hind wings). Conservative venational nomenclature is used and the view expressed by Makarkin *et al.* (2009) that the radius and media are not fused basally in Neuroptera is adopted. The division of the media into MA and MP is only used where the stem of M has a clear primary dichotomous basal fork with each branch forming a reasonably distinct vein system. All figures are inked line drawings prepared using a camera lucida attachment on a Motic stereomicroscope. To facilitate comparison, all specimens are figured as right wings. Abbreviations for collections are as follows: ACC – Allan Carsburg Collection, Brisbane (to be deposited in QM); GSQ – Geological Survey of Queensland (all specimens now transferred to the QM); QM – Queensland Museum; UQ – University of Queensland (all specimens now transferred to the QM).

The fossil localities

The Denmark Hill fossil lacewings recorded by Tillyard (1917, 1919, 1922, 1923) and Riek (1956) were collected in grey shales of the Late Triassic (Carnian) Blackstone Formation, the uppermost member of the Ipswich Coal Measures (Purdy and Cranfield 2013). The exposure, which is no longer accessible, was in a small quarry in what is now the Denmark Hill Conservation Park (-27.622° 152.756°) in the city of Ipswich. The site was documented in detail by Dunstan (1923).

The Dinmore locality (-27.606° 152.827°), also in the Blackstone Formation, is a small commercial clay pit in Dinmore, a suburb of Ipswich, approximately seven kilometres east of Denmark Hill. The site has been well documented by Rozefelds and Sobbe (1987). The lithology and composition of the insect fauna are more or less identical to those of Denmark Hill.

The Mount Crosby insects occur in green shales of the Mount Crosby Formation and have been collected at five separate exposures designated as Fossil Insect Localities A, B, C, D and E (details in Allen 1961), in the vicinity of Mount Crosby, north of Ipswich. The specimens discussed herein were collected at Localities B (-27.552° 152.782°) and C (-27.550° 152.769°). The Mount Crosby Formation, also dated as Carnian, is the basal sedimentary member of the Ipswich Coal Measures (Purdy and Cranfield 2013). The fossil insects are thus slightly older than those of the Blackstone Formation at Denmark Hill and Dinmore.

The Gayndah species described herein was collected in grey shales of the early (Anisian) Middle Triassic Gayndah Formation (Purdy 2013), in a road cutting (-25.615° 151.640°) approximately three kilometres ENE of the town of Gayndah. A species of the lacewing genus *Lithosmylidia* Riek has also been recorded from the same site (Lambkin 1988).

Systematics

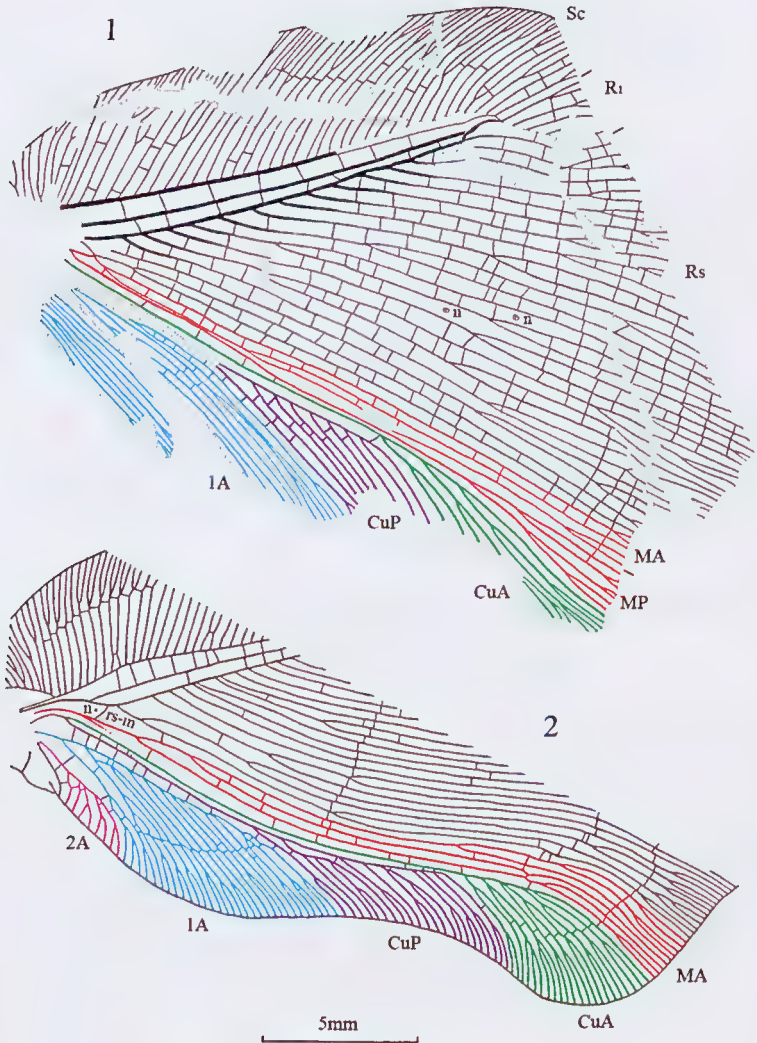
Family Psychopsidae Handlirsch
Triassopsychops superbus Tillyard
(Figs 1, 3)

Triassopsychops superba Tillyard, 1922: 467-469, text-fig. 89, plate 52.

Material examined. *Holotype* GSQ 284a, Denmark Hill, incomplete forewing, part only, length (along Sc) 21 mm, width 21 mm; ACC I.100, Dinmore, Queensland, right forewing fragment, part only, length 14.5 mm, width 15 mm.

Notes. The only previous illustrations of *T. superbus* have been photographs by Tillyard (1922, plate 52) and Jell (2004, p. 84), and a line drawing by Tillyard (1922, text-fig. 89). While Tillyard's photograph is adequate, his line drawing is one of his 'restorations', with much surmise and many inaccuracies and, for some reason, was printed upside down. Jell's new photograph is not all that clear and, apparently based on Tillyard's restoration, is also printed upside down.

Due to the state of preservation the identification of the veins in the M and Cu fields is problematical. This is especially true of the holotype where the wing in this area is broken and over-folded. The bases of both specimens are crushed, with the veins broken and/or artificially approximated. The holotype is flattened and has some veins showing as moulds and some as castes. It has therefore not been possible to determine if it is a left or right wing or make any confident determinations of vein convexities or concavities.



Figs 1-2. Psychopsidae. (1) *Triassopsychops superbus*, holotype GSQ 284a, Denmark Hill. (2) *Psychopsis illidgei*, ♀, Tamborine Mountain, Queensland, in QM, right forewing. *n* nygma; *rs-m* basal crossvein between R_s and M.

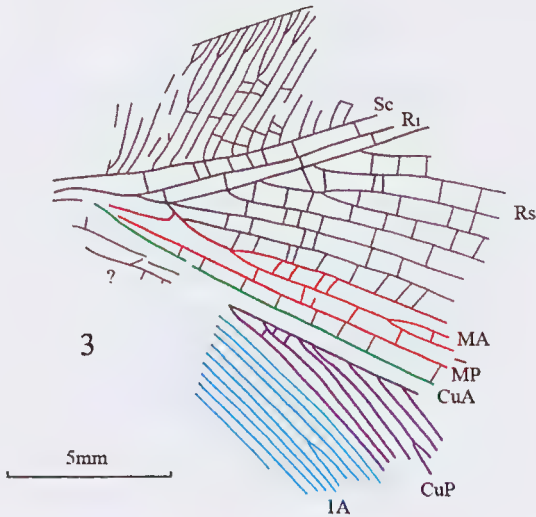


Fig. 3. *Triassopsychops superbus*, ACC I.100, Dinmore.

The venational interpretation herein, therefore, is based on as close as possible examination of the wing bases, the vein convexities or concavities in ACC I.100, and comparison of the relative length and extent of the M and Cu fields with those in the most similar living psychopsid, *Psychopsis illidgei* Froggatt (Fig. 2).

The drawings of the holotype (Fig. 1) and the new Dinmore specimen (Fig. 3) illustrate the following pertinent information about the wing and the venation of *T. superbus*:

1. The angle of the basal subcostal veinlets suggests the presence of a recurrent humeral vein (Fig. 1).
2. No trichosors were detected on the preserved wing margins.
3. The costal space does not taper and is almost as wide apically as it is basally (Fig. 1).
4. The crossveins of the costal space are random basally (Figs 1, 3), although there is a suggestion of an alignment apically in the holotype (Fig. 1).
5. Sc, R₁ and Rs appear to form a true 'vena triplica': strongly aligned, apparently almost parallel and not noticeably convergent apically (although the holotype is not clearly preserved in this area) and braced by crossveins for the entire length (Figs 1, 3).

6. Two nygmata are present in the central radial field (Fig. 1).
7. Most branches of Rs are dichotomously forked within the discal area of the wing (Fig. 1).
8. The radial and medial fields have numerous irregularly spaced crossveins, although there is alignment into gradate series in apical half of sectors in the holotype (Figs 1, 3).
9. M occupies a small area of the central portion of the wing and is dichotomously branched into MA and MP extreme basally, before the origin of Rs (Figs 1, 3).
10. The stem of MA curves antieriad basally and either just touches (Fig. 1), or is fused for a short distance with (Fig. 3), the basal branch of Rs.
11. MA has three long dichotomous branches, simple for most of their lengths (Figs 1, 3).
12. MP is simple to beyond half its length, then dichotomously branched (Figs 1, 3).
13. The space between MP and CuA is braced by numerous crossveins (Fig. 3).
14. The base of CuA in ACC I.100 is convex, although its longitudinal section is neutral. CuA is simple to about half its length, then dichotomously branched.
15. CuP is concave in ACC I.100 and is extensively pectinately branched (Figs 1, 3).
16. 1A is extensively pectinately branched (Figs 1, 3).

I consider that the presence of a uniformly broad costal space, an apparent true '*vena triplica*', the outer radial and medial cross-veins at least partly aligned into gradate series and the richly pectinate CuP and 1A, are all apomorphies of Psychopsidae and provide good evidence that *T. superbus* is indeed the oldest true psychopsid. In this regard, it is worth noting the similarities in these characters to those in the only living species of similar size, *P. illidgei* (Fig. 2). *Triassopsychops superbus*, however, has a suite of plesiomorphies not found in extant psychopsids, viz. the much more randomly placed crossveins, the presence of nygmata in the radial field, the extensive dichotomous branching of the Rs branches within the discal area, the retention of MP as a separate longitudinal vein (only the weakly sclerotised stem remains in *P. illidgei* - see Fig. 2) and the dichotomous branching of CuA. The peculiar up-curving of the stem of MA to touch or fuse for a short distance with the basal branch of Rs is considered an autapomorphy for the genus. In living psychopsids, e.g. *P. illidgei* (Fig. 2), *Psychopsis mimica* Newman, *Psychopsis elegans* (Guérin), *Psychopsis*

barnardi Tillyard, and *Psychopsis insolens* McLachlan (specimens in QM collection; see also New 1988, Oswald 1993) and in the Baltic amber *Propsoyopsis lapicidae* MacLeod (MacLeod 1970, fig. 8), the stem of MA does not curve towards the Rs but is joined to its base by an upright or forwardly inclined crossvein (Fig. 2). *Triassopsychops superbis* must have been an impressively large lacewing, with a total forewing length, based on the size of the holotype, of around 30 mm.

Peng *et al.* (2011) listed 35 Mesozoic and Tertiary fossil species that have been ascribed to Psychopsidae and, with additions by Jepson *et al.* (2012) and Makarkin *et al.* (2012), the number now stands at 41. Many of these are fragmentary and/or poorly illustrated, so their relationships thus remain uncertain. Based on the available illustrations, many have similarities with *Osmypsoyops* Tillyard, the type genus of the family Osmypsoyopidae, and may be more accurately placed in that family. Peng *et al.* (2011) suggested a division of the fossil psychopsids into two groups. The first group, which includes all extant genera as well as five from the Cretaceous and Eocene, has the branches of Rs in the discal field simple, crossveins of the costal space arranged in one or two gradate series and those of the radial field in two to four gradate series. The second group, which includes the remaining Mesozoic species in their list, including *Triassopsychops*, has the branches of Rs in the discal field dichotomously branched and the crossveins of the costal space and the radial field random or at most forming many short, irregular gradate series.

Family Osmypsoyopidae Martynova

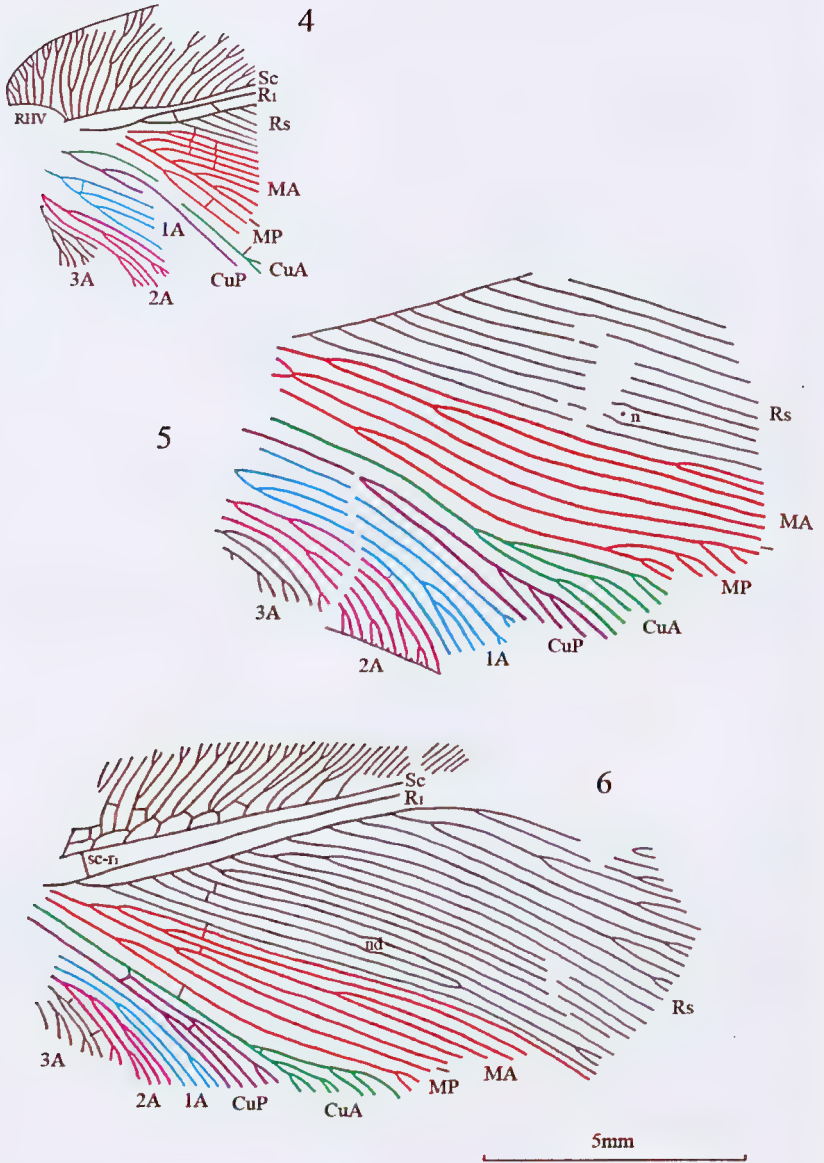
Osmypsoyops spillerae Tillyard

(Figs 4-8)

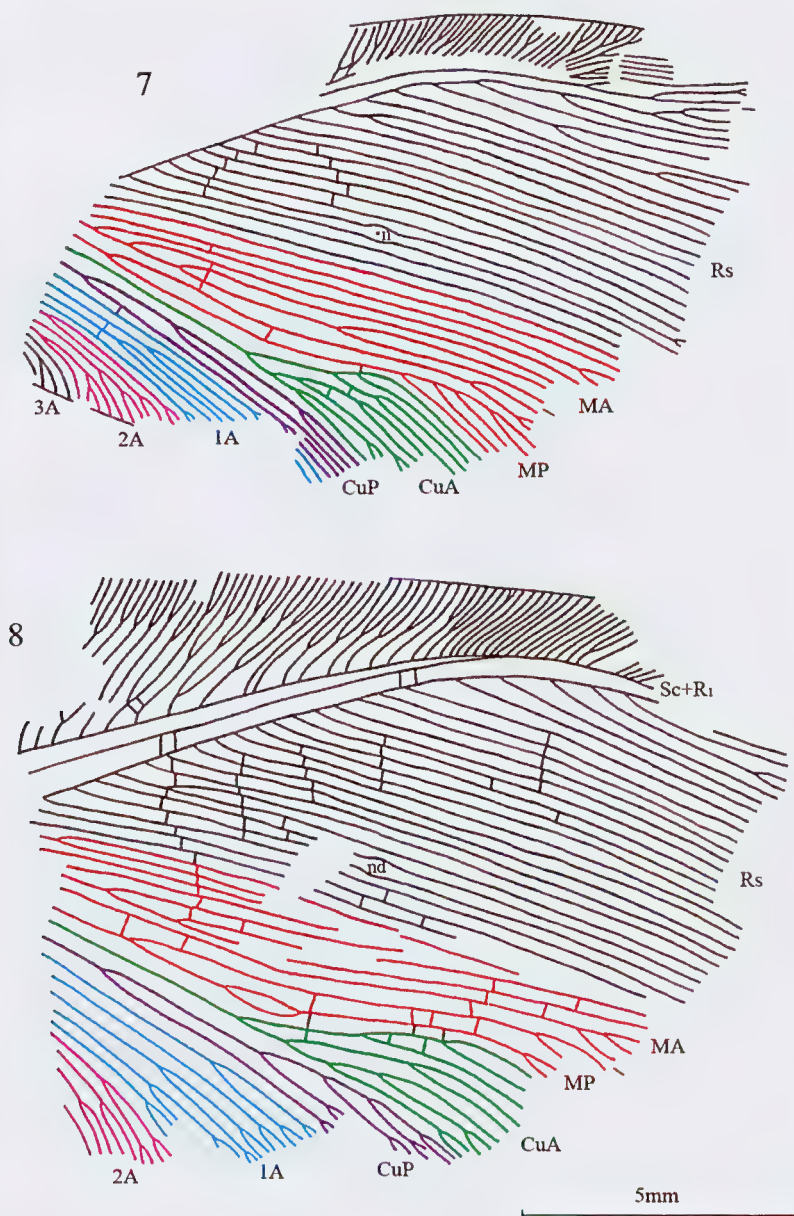
Osmypsoyops spillerae Tillyard, 1923: 496-497, text-fig. 93, plate 43.

Material examined. QM F57529, Dinmore, incomplete right forewing, part and counter-part, length 8 mm, width 7 mm; ACC I.101, Dinmore, incomplete right forewing, part only, length 14 mm, width 11.5 mm; QM F57530, Mount Crosby, Locality B, right forewing fragment, part only, collected by K.J. Lambkin, length 10.5 mm, width 7.5 mm; ACC I.102A, B, Mount Crosby, Locality B, incomplete left forewing, part and counter-part, length 12 mm, width 8.5 mm; ACC I.19A, B, Mount Crosby, Locality C, incomplete left forewing, part and counter-part, length 14 mm, width 6.5 mm.

Notes. *Osmypsoyops spillerae* is the most frequently collected and best documented lacewing from the Queensland Triassic. In 1992, I reconstructed an almost complete forewing based on several well-preserved specimens from Mount Crosby (Lambkin 1992). There are now five additional forewings, three from Mount Crosby and two from the Dinmore locality of the Blackstone Formation (Figs 4-8), which tell us more about the wing and venation of this species.



Figs 4-6. *Osmylopsychops spillerae*: (4) QM F57529, Dinmore; (5) QM F57530, Mount Crosby; (6) ACC I.19A, B, Mount Crosby. *n* nygma; *nd* dilation of veins suggesting presence of nygma; *RHV* recurrent humeral vein; *sc-r₁* crossvein between Sc and R₁.



Figs 7-8. *Osmylopsychops spillerae*: (7) ACC I.102A, B, Mount Crosby; (8) ACC I.101, Dinmore. *n* nygma; *nd* dilation of veins suggesting presence of nygma.

In all specimens CuA is noticeably convex, which identifies them as forewings. The vein system interpreted as MA is identified as such on the grounds that it has a common basal stem with the system identified as MP, as demonstrated in the clearly preserved specimen illustrated in Lambkin (1992, fig. 6) and also strongly suggested in new specimens QM F57529 and ACC I.19A, B (Figs 4, 6).

QM F57529 (Fig. 4) confirms the presence of a recurrent humeral vein at the base of the costal space, as conjectured by Tillyard (1923, text-fig. 93). This is the first specimen to preserve this area of the wing. The recurrent humeral vein is generally present in both fossil and extant psychopsoids (Makarkin *et al.* 2013) and is clearly present in the only other well enough preserved osmylopsychopid, an undescribed species from the Middle to Late (Ladinian-Carnian) Triassic Madygen Formation of Kyrgyzstan (Shcherbakov 2008, fig. 6; V.N. Makarkin pers. comm.).

The other important information that the new material demonstrates is the degree of intra-specific variation in wing size and venation. Figures 4-8 are all drawn to the same scale and demonstrate the size range of the species, from ACC I.19 (Fig. 6) of width 6.5 mm, to the comparable fragment of ACC I.101 (Fig. 8), almost twice as large at width 11.5 mm. Similar variation also occurs in extant psychopsoids that demonstrate a degree of sexual dimorphism in size, the males being generally smaller than the females. For instance, the good series of specimens of *Psychopsis insolens* in the QM range from forewing length 11 mm and width 6 mm (♂, Toowoomba, Queensland), to forewing length 18 mm and width 11 mm (♀, Killarney, Queensland). The size variation in the QM specimens of the spectacular *Psychopsis illidgei* is equally as stark, ranging from forewing length 23 mm and width 14 mm (♂, Bunya Mountains, Queensland), to forewing length 31 mm and width 20 mm (♀, Tamborine Mountain, Queensland). In many specimens, the size difference is also reflected in the richness of the venation, particularly the number of pectinate branches of Rs. In *P. insolens* these vary from eight in the Toowoomba ♂ to 13 in the Killarney ♀, and in *P. illidgei* from 19 in the Bunya Mountains ♂ to 28 in the Tamborine Mountain ♀.

With regard to the venation, even though the basic pattern is consistent across all specimens (Figs 4-8; Lambkin 1992, figs 3-8), the venational details can vary quite considerably. Much of the variation appears to be related to wing size, with the larger wings generally possessing more vein branches and more bracing cross-veins. Details of the variation are as follows:

1. The crossveins of the costal space may be apparently absent or almost so (Figs 4, 8; Lambkin 1992, fig. 3), sparse in number and forming a simple gradate series (Lambkin 1992, figs 6, 8), or anastomosed with the stems of the subcostal veinlets to form a network running parallel to Sc (Fig. 6; Lambkin 1992, fig. 5).

2. A basal crossvein between Sc and R₁ just beyond the origin of Rs is present in the three specimens where this area of the wing is well preserved (Fig. 6; Lambkin 1992, figs 5, 6). Its apparent absence in QM F57529 (Fig. 4) is considered to be preservation related. No other subcostal crossveins were detected in any of the specimens examined.
3. R₁-Rs crossveins seem to vary in position and angle (Figs 4, 8; Lambkin 1992, fig 5), and were not detected at all in ACC I.19 (Fig. 6).
4. The number of pectinate branches of Rs and the pattern of their dichotomous branching are not the same in any two specimens (Figs 5-8; Lambkin 1992, fig. 5), ranging from approximately 24 branches with only one dichotomously branched in the large ACC I.101 (Fig. 8), to only approximately 14 branches with three of these dichotomously branched in the much smaller ACC I.19 (Fig. 6).
5. A nygma is consistently present between the second and third, third and fourth, or fourth and fifth branches of Rs, either as a detectable spot (Figs 5, 7; Lambkin 1992, fig. 5), or at least evidenced by a slight dilation of the veins (Figs 6, 8).
6. Crossveins of the radial, medial, cubital and anal fields are generally difficult to detect and are as indicated in Figs 4-8 and the figures in Lambkin (1992); those that have been tentatively detected vary considerably in number and position, from very few (Fig. 5; Lambkin 1992, fig. 5), to more numerous and forming irregular gradate series (Figs 7, 8).
7. The basic branching pattern and shape of M is quite constant, *i.e.* primary forking into MA and MP at the base of the wing, well before the origin of Rs; MA forked close to its origin and multi-branched, occupying a large area in the centre of the wing; MP forked dichotomously well beyond the primary fork of MA, the branches parallel, somewhat sinuous, and simple for most of their length. The number and pattern of branching of MA, however, varies considerably, from simply dichotomous with six major branches (Figs 5, 6), to strongly pectinate with as many as six anteriorly-directed branches mirroring the pectination Rs (Figs 4, 7). The only variation in MP is the presence in some specimens of an enclosed cell on MP₃₊₄ (Fig. 8; Lambkin 1992, fig 3).
8. The pattern of Cu is fairly constant. CuA is simple and straight for much of its length, but then curved anteriorly and forked into eight or nine branches to form a broad, somewhat triangular area apically (Figs 7, 8; Lambkin 1992, fig. 5). CuP forks earlier than CuA, about at the level of the primary fork of MP (Figs 5-8; Lambkin 1992, fig 6) or more basally (Fig. 4) and the subsequent branching is a little variable (Figs 5-8; Lambkin 1992, figs 3, 5).

9. The anal area of the wing is incomplete in most specimens and the identification of 1A, 2A and 3A in Figs 5-8 is a best estimate based on the pattern in QM F57529 (Fig. 4) and in the wing base illustrated in Lambkin (1992, fig. 6). Comparison of the figures again indicates a consistent pattern of dichotomous branching, but with variation in the details of the more apical branching of the veins.

In summary, the new specimens recorded herein further augment our knowledge of the wing and venation of *O. spillerae*, making it one of the best documented fossil lacewings. The degree of intra-specific variation is of particular note as a cautionary guide to the proliferation of species names for fossil Neuroptera based only on trivial venational differences.

Petropsychops superbis Riek

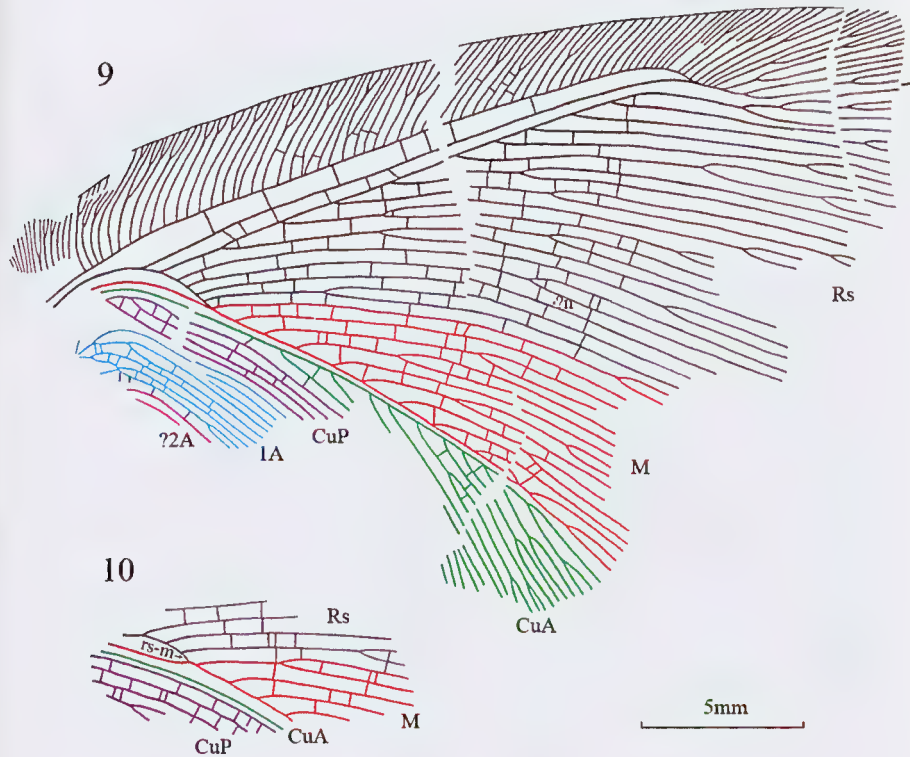
(Figs 9-10)

Petropsychops superba Riek, 1956: 104-105, fig. 2.

Material examined. *Holotype* UQ C2135-6, Denmark Hill, incomplete left forewing, part and counterpart, length 28 mm, width 18 mm; QM F57531, Mount Crosby, Locality B, left forewing fragment, part and counterpart, collected by K. J. Lambkin, length 10.5 mm, width 4 mm.

Notes. This species, previously known only from the holotype specimen collected at Denmark Hill, is now also recorded (QM F57531) from the slightly older Mount Crosby Formation. The only previous illustrations of *P. superbis* have been photographs by Riek (1956, fig. 2), Jell (2004, p. 83) and Grimaldi and Engel (2005, 9.15). The drawings of the holotype (Fig. 9) and the new Mount Crosby specimen (Fig. 10) presented herein illustrate the following pertinent information about the wing and the venation of *P. superbis*:

1. The angle of the basal subcostal veinlets suggests the presence of a recurrent humeral vein (Fig. 9).
2. No trichosors were detected on the preserved wing margins.
3. The costal space tapers to be almost as half as wide apically as it is basally (Fig. 9).
4. The crossveins of the costal space are few in number and not arranged into gradate series (Fig. 9).
5. SC, R₁ and R_s are more or less parallel for their entire lengths, but with the apex of Sc curved posteriad to fuse with R₁. There are several randomly placed crossveins (Fig. 9).
6. Most of the branches of R_s are dichotomously forked within the discal area of the wing (Fig. 9).



Figs 9-10. *Petropsychoops superbus*: (9) holotype UQ C2135-6, Denmark Hill; (10) QM F57531, Mount Crosby. *n* nygma; *rs-m* basal crossvein between Rs and M.

7. There is a raised spot which may be a nygma between the 2nd and 3rd branches of Rs (Fig 9). It is, however, not clearly preserved and is not centred between the veins as nygmata usually are.
8. The proximal radial and medial fields have numerous randomly spaced crossveins, but none is present beyond the level of the apex of Sc (Fig. 9).
9. The first branch of Rs (Rs₁) and the stem of M form a peculiar structure at the base of the wing, interpreted as follows: Rs₁ curves posteriad just beyond the origin of Rs, throws off three or four pectinate branches parallel with the remaining branches of Rs and those of M, and is then connected to the stem of M by a short, oblique crossvein (*rs-m* in Fig. 10) that appears to be a continuation of Rs₁. An alternative interpretation of the structure is that the system identified as Rs₁ is indeed a multi-branched MA formed by the sharp recurving of the stem of MA (*rs-m* in

- the interpretation above), which then throws off four pectinate branches and is joined to the base of Rs by a short Rs-MA crossvein.
10. The stem of M is strongly concave and has at least 11 anteriorly-directed pectinate branches, mostly dichotomously forked, which parallel those of Rs. M thus occupies a considerable area of the centre of the wing (Fig. 9).
 11. The stem of CuA is strongly convex, runs very closely and parallel with the stem of M and has numerous, mostly dichotomously forked, pectinate branches that almost precisely mirror those of M (Fig. 9).
 12. CuP is deeply dichotomously forked with four or five main branches and numerous crossveins (Figs 9, 10).
 13. 1A is deeply dichotomously forked, with approximately nine main branches and numerous crossveins (Fig. 9).

Petropsychops superbus, as its species name alludes, must have been a superbly impressive lacewing with a total forewing length, judging by the size of the holotype, of just over 30 mm. The peculiar structure of Rs₁ and the stem of M appears to be unique among Neuroptera and is a strong autapomorphy for the genus. The relationship of *Petropsychops* to other psychopsoids, however, remains problematical. As noted by Riek (1956), the strong anterior pectination of M is a characteristic of some genera of Kalligrammatidae, the psychopsoid family considered by Makarkin *et al.* (2009) as the sister group of Osmylpsychopidae. Indeed, the similarity of both M and CuA in *P. superbus* to those veins in the recently described kalligrammatid *Apochrysogramma rotundum* Yang, Makarkin and Ren is striking (see Yang *et al.* 2011, fig. 5). *P. superbus*, however, lacks the very characteristic remigial 'eye' spot and extremely dense crossvenation of Kalligrammatidae (Ren and Engel 2008). On these grounds, as well as its similarity to *Osmylpsychops*, which, as demonstrated herein, also shows a tendency to the anterior pectination of at least MA (Figs 4, 7), it is considered that, for the present, *Petropsychops* is best retained in Osmylpsychopidae. The difficulty of its family placement again emphasises the issue raised by many authors (*e.g.* Makarkin 2010, Peng *et al.* 2010, Peng *et al.* 2011) of the need for a comprehensive analysis of the family classification of the Mesozoic psychopsoids, which as a result of the many recent discoveries are now known to be highly diverse and species-rich (see lists in Yang *et al.* 2009, and Peng *et al.* 2011).

Archepsychops triassicus Tillyard

(Fig. 11)

Archepsychops triassica Tillyard, 1919: 205-211, text-fig. 27.

Material examined. Holotype GSQ 137a, Denmark Hill, right forewing fragment, part only, length 7 mm, width 6.5 mm.

Notes. Tillyard's text figure is again somewhat of a 'restoration' and contains more veins than the specimen actually possesses. The only other previous illustration of the specimen is the photograph in Jell (2004, p. 83). The new drawing (Fig. 11) of *A. triassicus* demonstrates the fragmentary nature of its type specimen, which is a cast with both R_1 and CuA strongly convex thus indicating a forewing. The vein labelled Cu by Tillyard is actually a deep groove in the wing and not a vein.

Riek (1955) placed *A. triassicus* in the Osmylopsychopidae and suggested that *O. spilleriae* might be its junior synonym. Indeed, the very fragmentary specimen from Mount Crosby (UQ C679), which Riek tentatively referred to *A. triassicus*, is in fact a wing base fragment of *O. spilleriae* showing the anal veins and multi-branched MA similar to those illustrated in Lambkin (1992, fig. 2). Although it is quite likely that *A. triassicus* and *O. spilleriae* are indeed the same species (compare Fig. 11 with Figs 4-8 and the figures in Lambkin 1992), due to the fragmentary nature of the type of *A. triassicus* it would be unwise to synonymise the very well documented *O. spilleriae* with it. It also remains possible that *A. triassicus* is indeed distinct. As indicated in Fig. 11 it does have at least four crossveins between Sc and R_1 , whereas no specimen of *O. spilleriae* has been found with more than one. The vein interpreted as CuP is much more deeply forked than in most specimens of *O. spilleriae* but, as listed above, the level of this forking in *O. spilleriae* is variable and the level in *A. triassicus* is the same as that in *O. spilleriae* specimen QM F57529 (Fig. 4).

Genus *Gayndahpsychops* gen. n.

Type species *Gayndahpsychops carsburgi* sp. n.

Diagnosis. Forewing. Relatively small size, width approximately 7.5 mm; M occupying a large area in centre of wing; MA with two deep dichotomous forks at level of origin of Rs; MA_1 fused with the apparent posterior branch of Rs_1 , this fused vein then fused with the apparent anterior branch of Rs_1 ; MP simple for about half its length, then dichotomously forked; CuA with seven long posteriorly-directed pectinate branches which occupy a large area of the wing; CuP deeply dichotomously forked basal to the origin of Rs, each branch simple for most of its length.

Etymology. The generic name recognises the locality of the type species, the Gayndah Formation at Gayndah in southeastern Queensland.

Notes. *Gayndahpsychops* is placed in Osmylopsychopidae because of its basic psychopsoid facies, its small size, lack of well defined gradate crossvein series, lack of extremely dense crossvenation and an eye-spot and, most importantly, the extensive nature of M, which I consider is synapomorphic with the type genus of the family, *Osmylopsychops*. It differs

from *Osmylopsychops* in the complex fusions of MA₁ and Rs₁ (these veins are not connected in any of the many specimens of *O. spilleræ*), the much more apically forked MP (forked just beyond origin of Rs in *Osmylopsychops*), the richly pectinate CuA, which occupies a large area of the wing (dichotomously forked and much less extensive in *Osmylopsychops*) and the deep dichotomous forking of CuP with the two branches simple for most of their length (mostly forked at about half length in *Osmylopsychops*, with CuP₁ deeply dichotomously forked). Beyond the type genus, the generic composition and limits of Osmylopsychopidae are poorly known. Other psychopsoid genera that have been ascribed to Osmylopsychopidae, e.g. *Actinophlebia* Handlirsch, *Parhemerobius* Bode (Makarkin and Archibald 2005), are not well enough documented to allow reliable comparison with *Gayndahpsychops*. It is of interest to note, however, that the undescribed osmylopsychopid from the Triassic Madygen Formation illustrated by Shcherbakov (2008, fig. 6) also seems to have CuA posteriorly pectinate.

***Gayndahpsychops carsburgi* sp. n.**

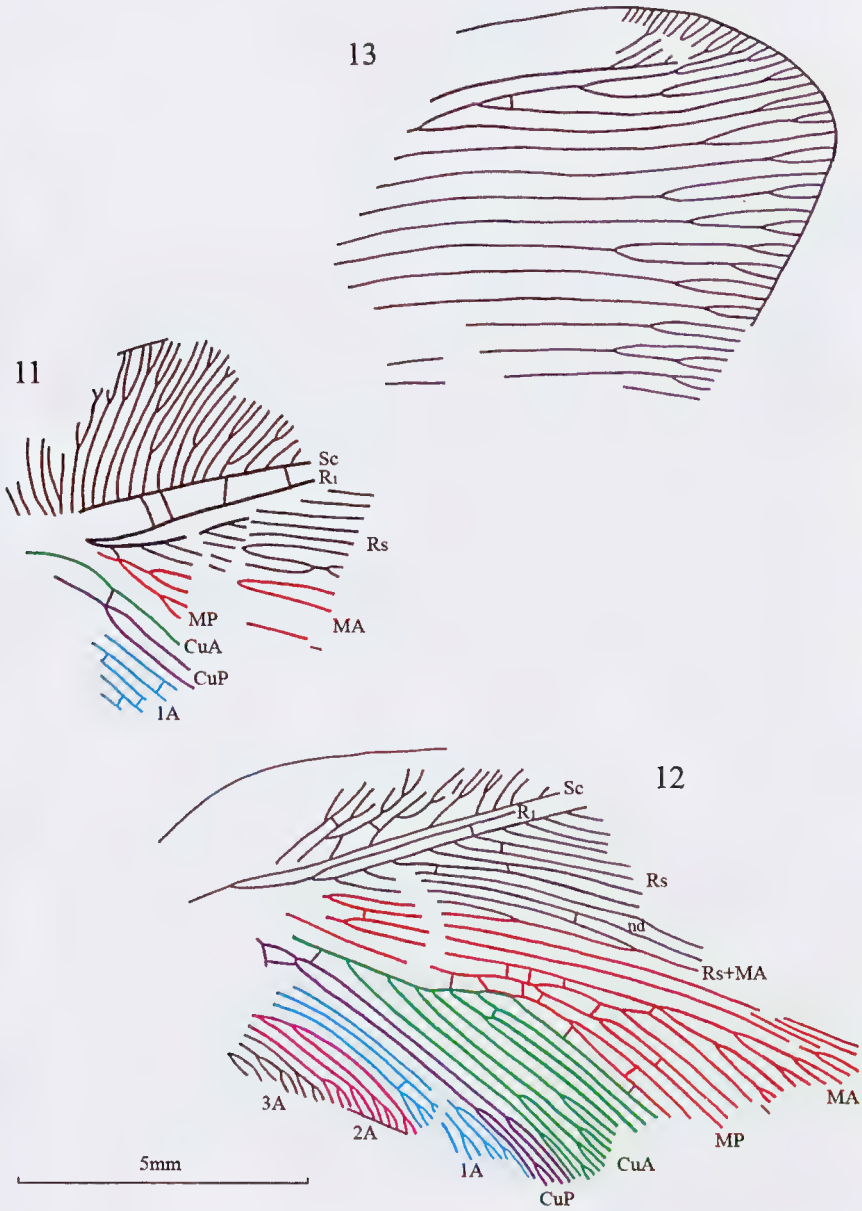
(Fig. 12)

Type and only specimen. Holotype, QM F57532, Gayndah fossil insect locality, incomplete right forewing, part and counterpart, collected by K.J. Lambkin, length 11.5 mm, width 7.5 mm.

Description. Forewing. Subcostal veinlets strongly inclined, dichotomously forked with at least two connecting crossveins; a basal Sc-R₁ crossvein not detected (wing not well preserved in this area); R₁ strongly convex; one R₁-Rs crossvein detected; Rs richly pectinate, the basal two branches apparently dichotomously forked, the other eight preserved branches simple at least basally; four randomly placed crossveins detected in Rs field; nygma not detected, but a small dilation in the 3rd and 4th apparent Rs branches suggests its presence; stem of M not preserved; one basal crossvein between MA₂ and MA₃; MA₄ dichotomously forked with at least seven marginal branches; MP fused with CuA for a short length, with six long apical branches; several randomly placed crossveins in the area of the forkings of MP; CuA strongly convex; one basal crossvein between CuA and CuP₁; at least five of the pectinate branches of CuA dichotomously forked; anal veins apparently quite extensive and dichotomously forked (the notional identification of 1A, 2A and 3A in Fig. 12 based on the pattern in *O. spilleræ*); trichosors not detected.

Etymology. Named in honour of Mr Allan Carsburg who collected most of the specimens which made this study possible.

Formation and Age. Gayndah Formation, early (Anisian) Middle Triassic.



Figs 11-13. (11) *Archeopsycho ps triassicus*, holotype GSQ 137a, Denmark Hill. (12) *Gayndahpsycho ps carsburgi*, holotype QM F57532, Gayndah. (13) *Protopsycho ps venosa*, holotype GSQ 160a, Denmark Hill. *nd* dilation in veins suggesting presence of nygma.

Neuroptera *incertae sedis*
***Protopsychopsis venosa* Tillyard**
 (Fig. 13)

Protopsychopsis venosa Tillyard, 1917: 178-180, plate VIII, fig. 3.

Material examined. Holotype GSQ 160a, Denmark Hill, wing fragment, part only, length 9 mm, width 7 mm.

Notes. Tillyard's figure is a line drawing and there is also a photograph of the holotype in Jell (2004, p. 83). As Fig. 13 demonstrates, the species is based on a specimen preserving only the apex of a wing that is too fragmentary to warrant further consideration. The only point of note is that the numerous crossveins illustrated in Tillyard's figure could not be detected in the specimen. For the sake of convenience, Riek (1956) placed the species in Osmylpsychopidae; however, it is simply too fragmentary for even tentative family placement and is thus designated Neuroptera *incertae sedis*.

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